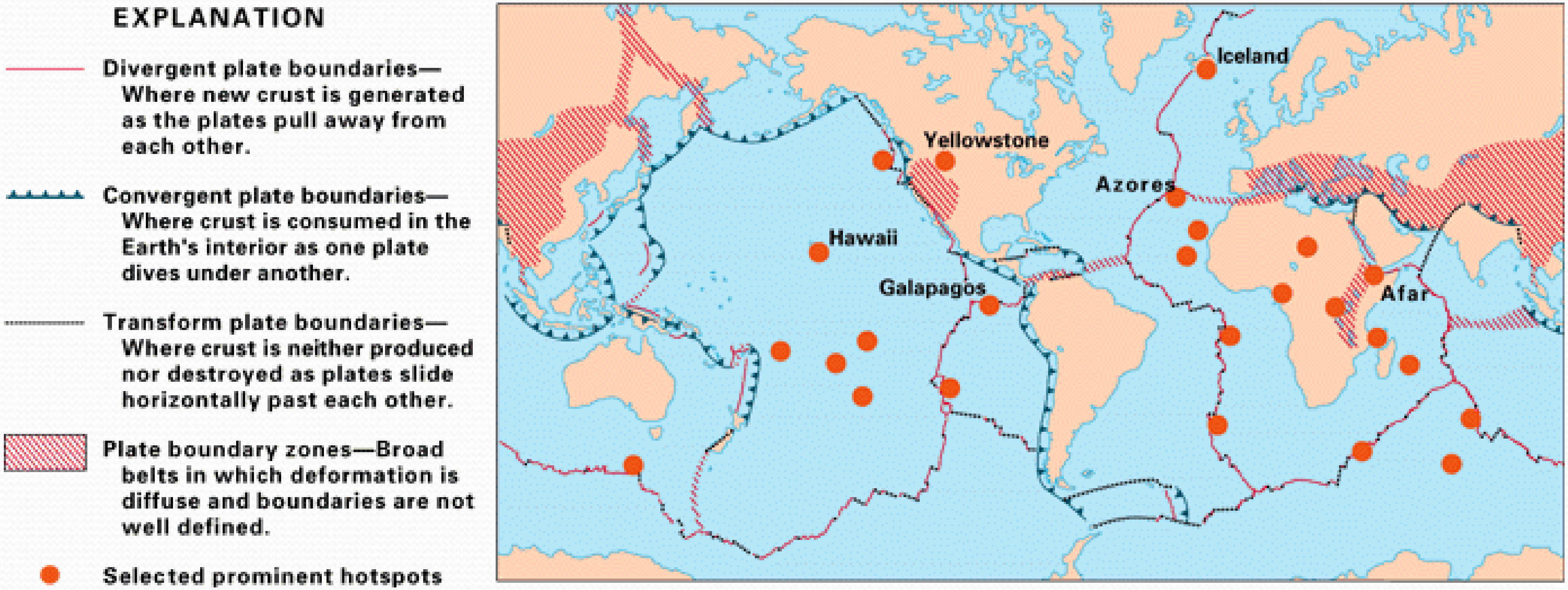
HOTSPOTS

INTRODUCTION

In geology, a hotspot is a location on the Earth's surface that has experienced active volcanism for a long period of time.

Main areas of hot spot activity globally



EXPLANATION

Divergent plate boundaries—Where new crust is generated as the plates pull away from each other.

Convergent plate boundaries—Where crust is consumed in the Earth's interior as one plate dives under another.

Transform plate boundaries—Where crust is neither produced nor destroyed as plates slide horizontally past each other.

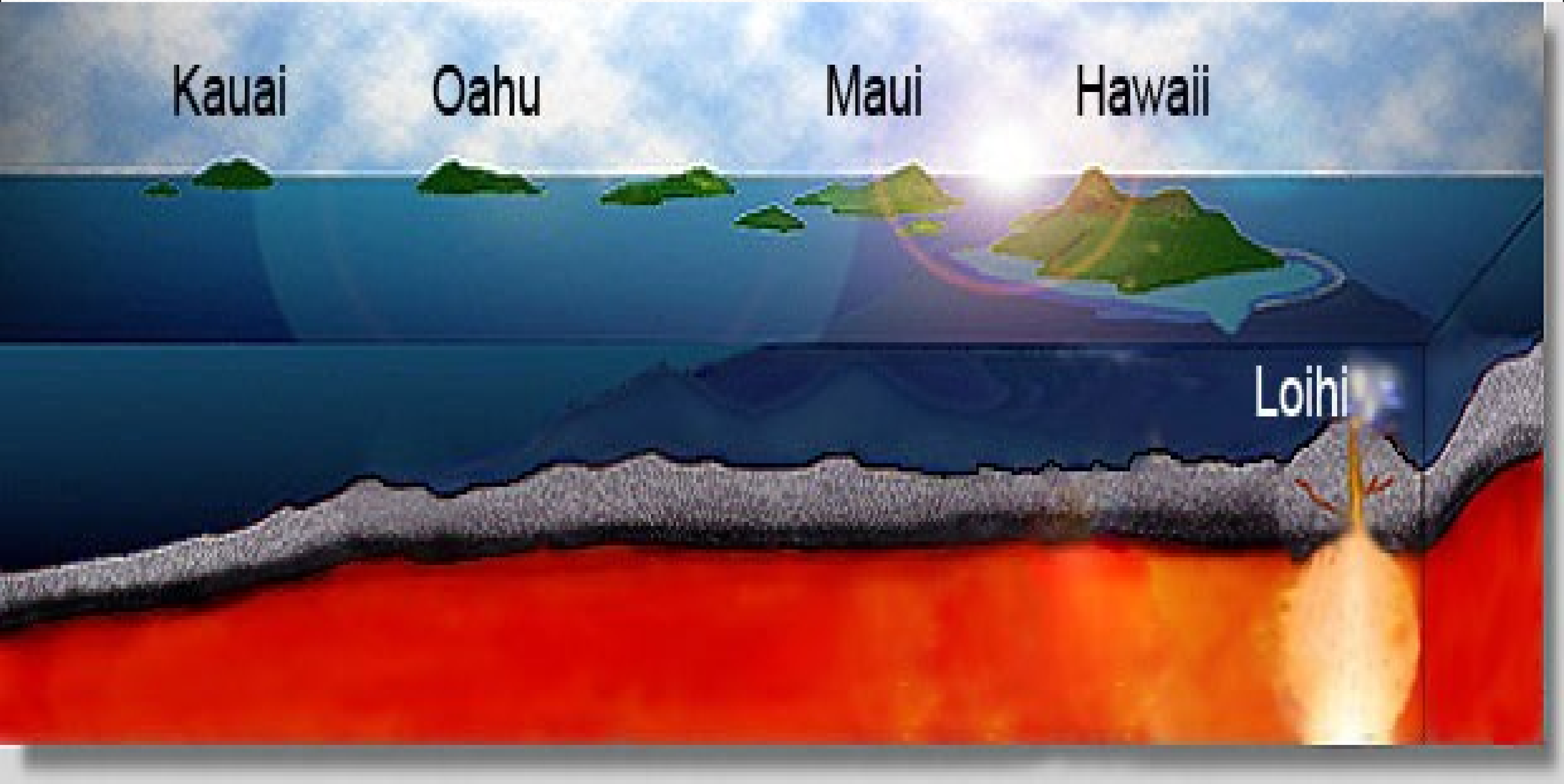
▨ Plate boundary zones—Broad belts in which deformation is diffuse and boundaries are not well defined.

● Selected prominent hotspots

PROMINENT HOTSPOTS

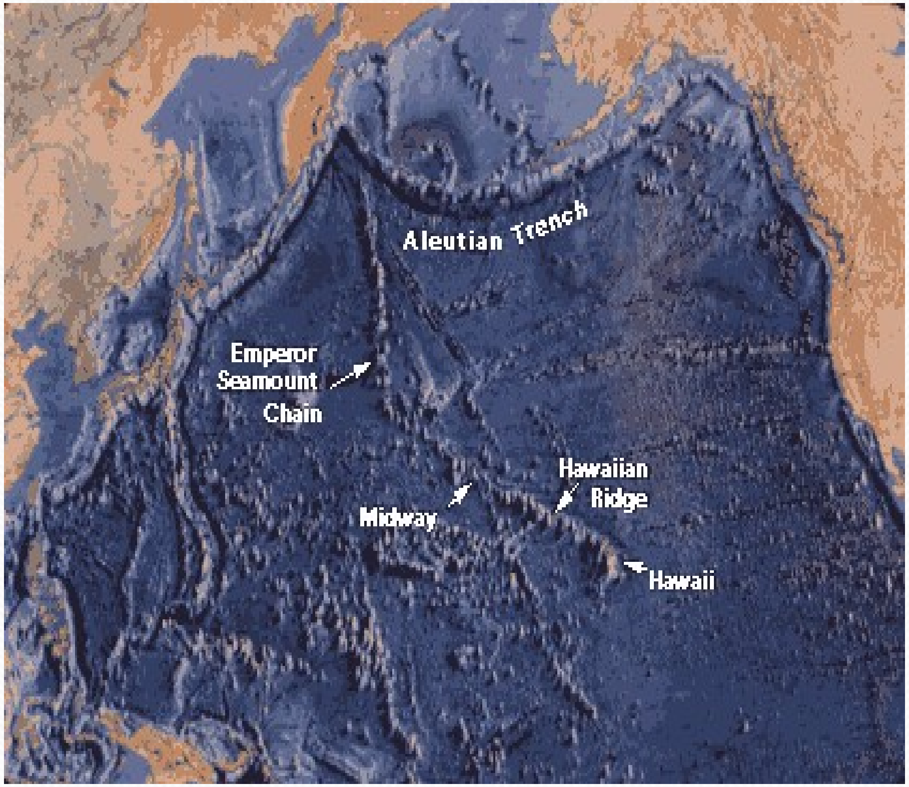
- **HAWAIIAN ISLAND HOTSPOT**
- **GALAPAGOS HOTSPOT**
- **ICELAND HOTSPOT**
- **YELLOWSTONE HOTSPOT**

CASE STUDY HAWAIIAN ISLANDS



Hawaiian Hot Spots

The long trail of the Hawaiian hotspot



Over the past 70 million years, the combined processes of magma formation, volcano eruption and growth, and continued movement of the Pacific Plate over the stationary Hawaiian "hot-spot" have left a long trail of volcanoes across the Pacific Ocean floor. The Hawaiian Ridge-Emperor Seamounts chain extends some 6,000 km from the "Big Island" of Hawaii to the Aleutian Trench off Alaska. The Hawaiian Islands themselves are a very small part of the chain and are the youngest islands in the immense, mostly submarine mountain chain composed of more than 80 volcanoes.

The hot spot issue

The vast majority of earthquakes and volcanic eruptions occur near plate boundaries.

The Hawaiian Islands, which are entirely of volcanic origin, have formed in the middle of the Pacific Ocean more than 3,200 km from the nearest plate boundary.

In certain locations around the world, such as Hawaii, volcanism has been active for very long periods of time. This could only happen, if relatively small, long-lasting, and exceptionally hot regions -- called *hotspots* -- existed below the plates

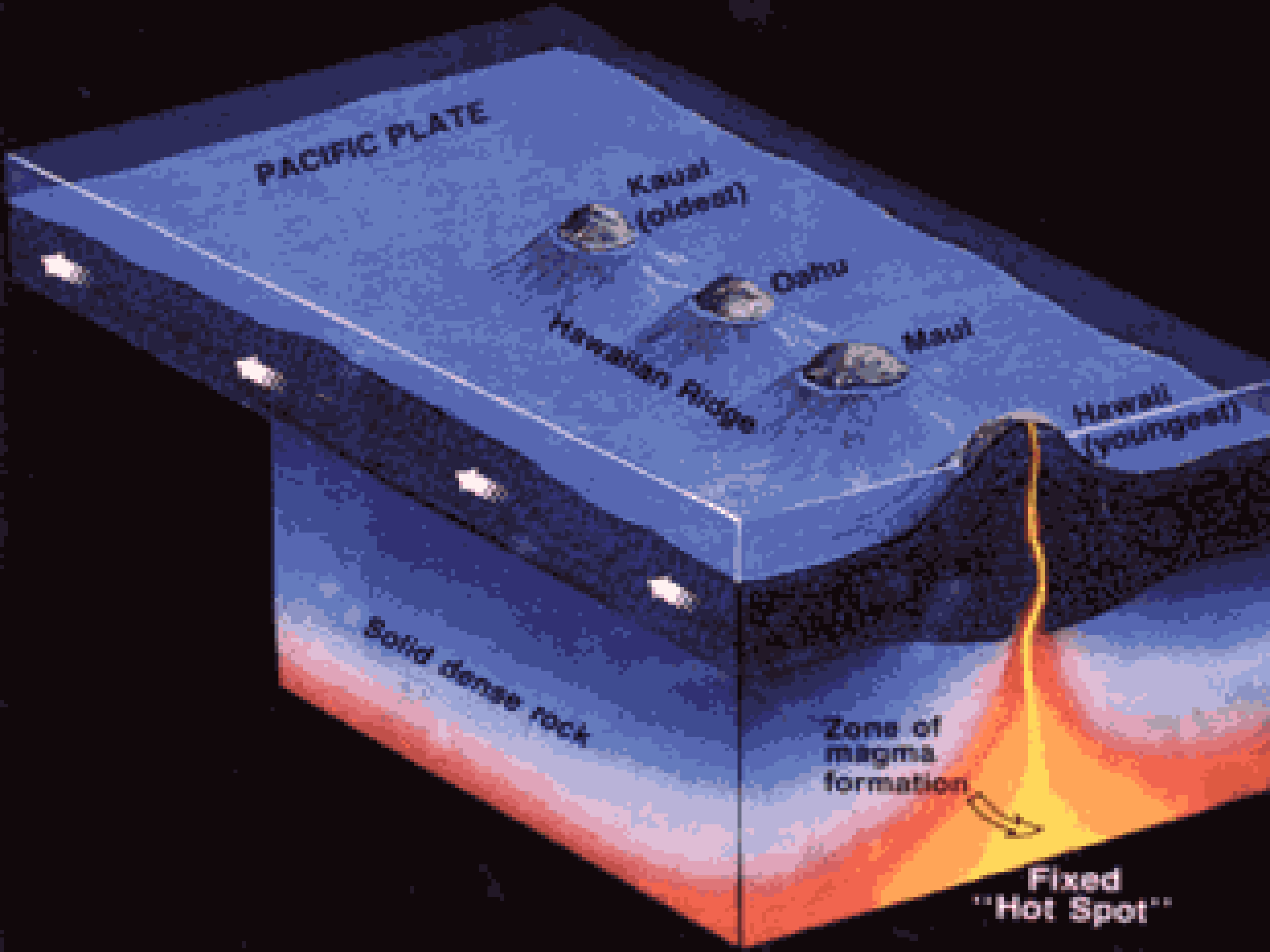
This would provide localized sources of high heat energy *(thermal plumes)* to sustain volcanism..

The shape of the Hawaiian Island-Emperor Seamounts chain resulted from the Pacific Plate moving over a deep, stationary hotspot in the mantle, located beneath the present-day position of the Island of Hawaii.

Heat from this hotspot produced a persistent source of magma by partly melting the overriding Pacific Plate.

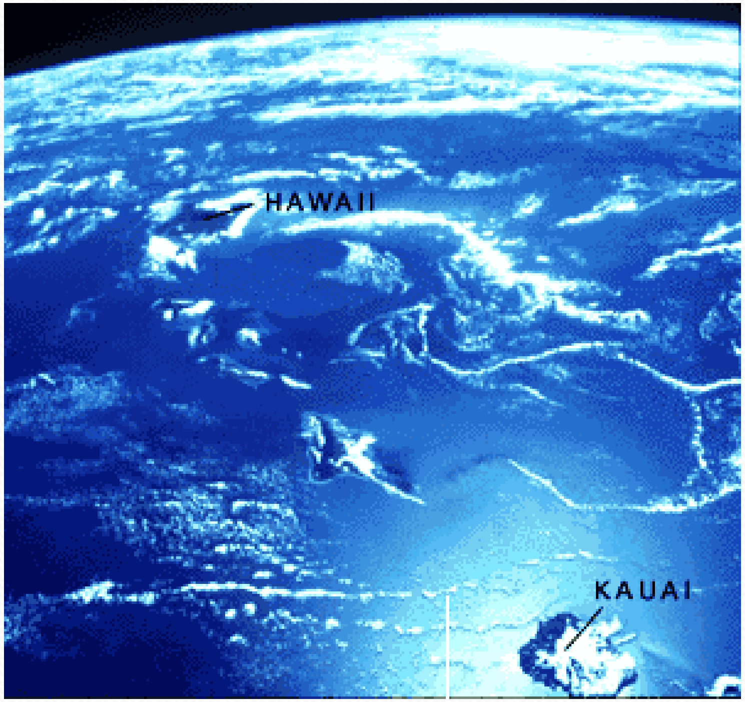
How a Hot Spot works

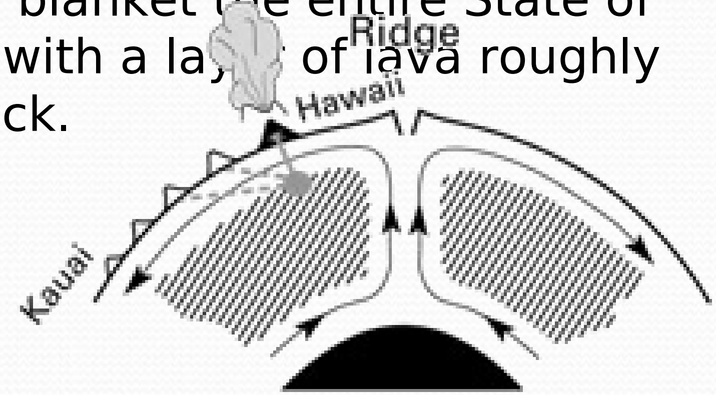
- The magma, which is lighter than the surrounding solid rock, then rises through the mantle and crust to erupt onto the seafloor, forming a mound of solid magma
- Over time, countless eruptions cause this to grow until it finally emerges above sea level to form an island volcano.
- Continuing plate movement eventually carries the island beyond the hotspot, cutting it off from the magma source, and volcanism ceases. As one island volcano becomes extinct, another develops over the hotspot, and the cycle is repeated.
- This process of volcano growth and death, over many millions of years, has left a long trail of volcanic islands and sea mounts across the Pacific Ocean floor.
- The Hawaiian chain should get progressively older and become more eroded the further they travel beyond the hotspot. The oldest volcanic rocks are on Kauai, the north-western most inhabited Hawaiian island, are about 5.5 million years old and are deeply eroded. By comparison, on the "Big Island" of Hawaii – south-eastern most in the chain and presumably still positioned over the hotspot -- the oldest exposed rocks are less than 0.7 million years old and new volcanic rock is continually being formed.


PACIFIC PLATE
Kauai
(oldest)
Oahu
Hawaiian Ridge
Maui
Hawaii
(youngest)
Solid dense rock
Zone of
magma
formation
Fixed
"Hot Spot"

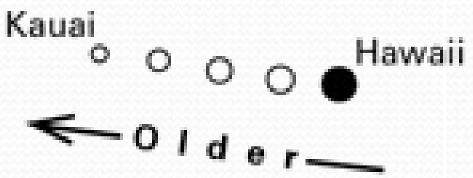
Hawaiian Ridge

The length of the Hawaiian Ridge segment alone, from the Big Island northwest to Midway Island, is about equal to the distance from Washington, D.C. to Denver, Colorado (2,600 km). The amount of lava erupted to form the Hawaiian-Emperor chain is calculated to be at least 750,000 cubic kilometers-more than enough to blanket the entire State of California with a layer of lava roughly 1.5 km thick.



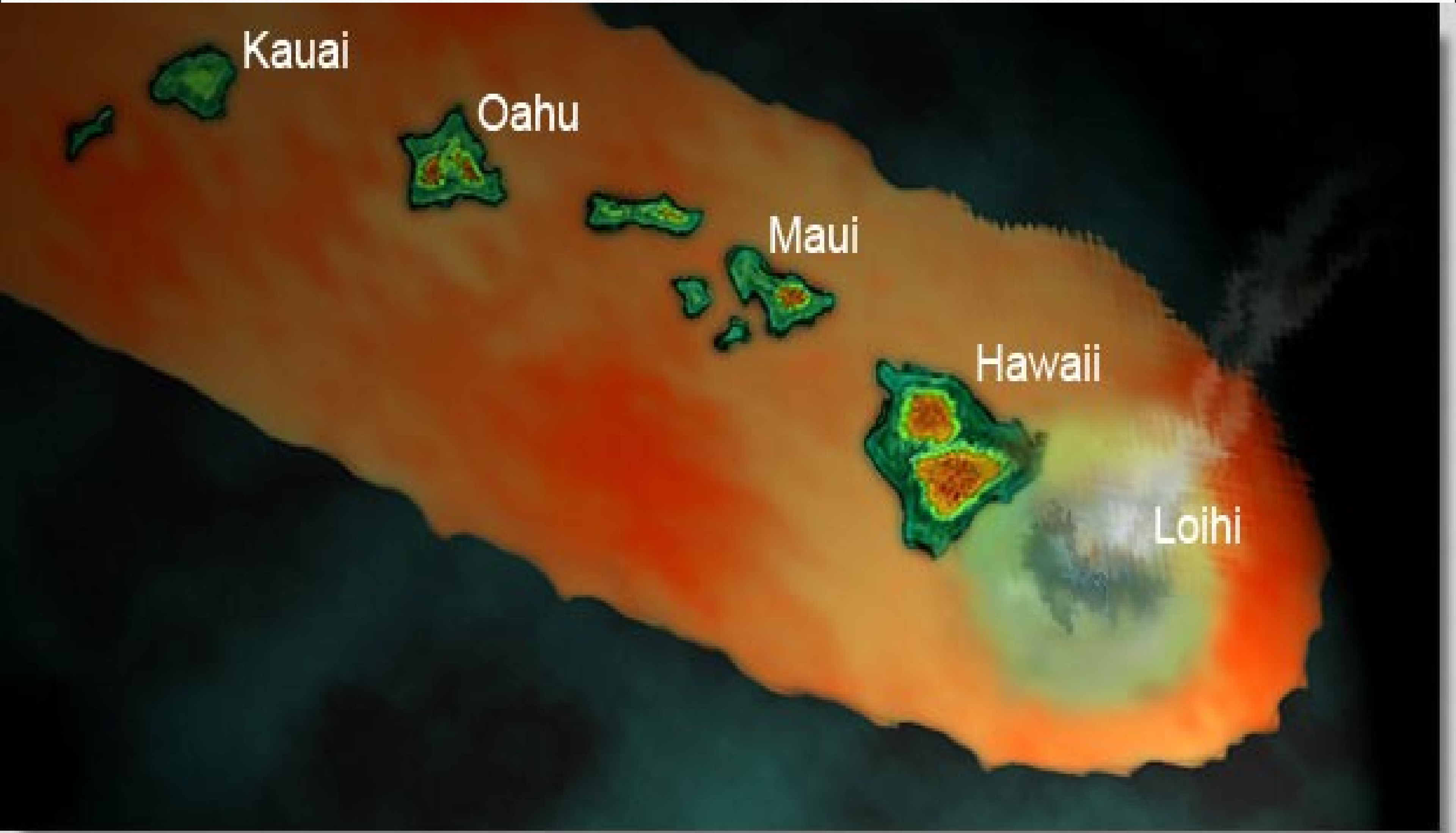


(a) Section



(b) Plan

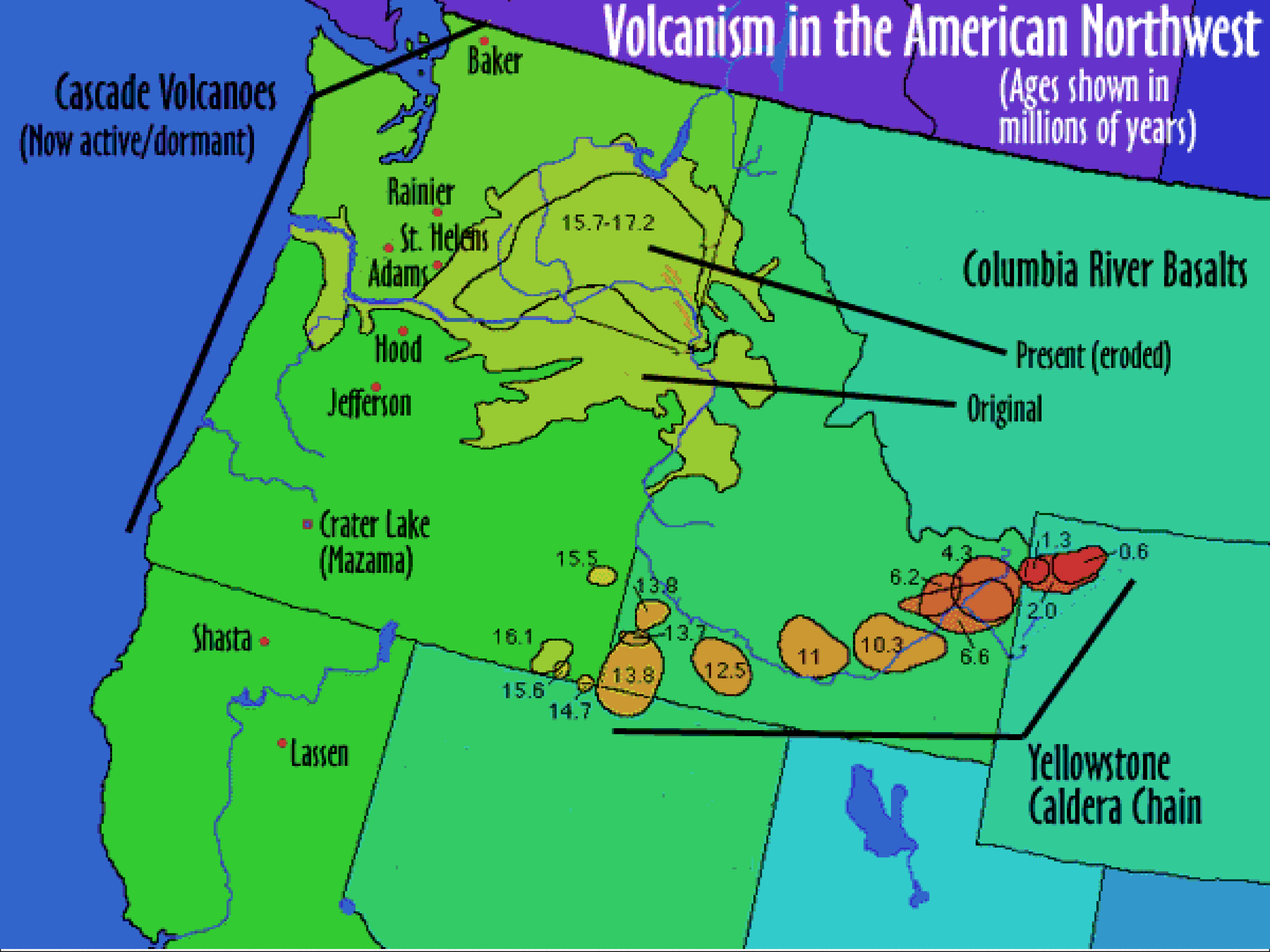
HAWAIIAN RIDGE



YELLOWSTONE HOTSPOT

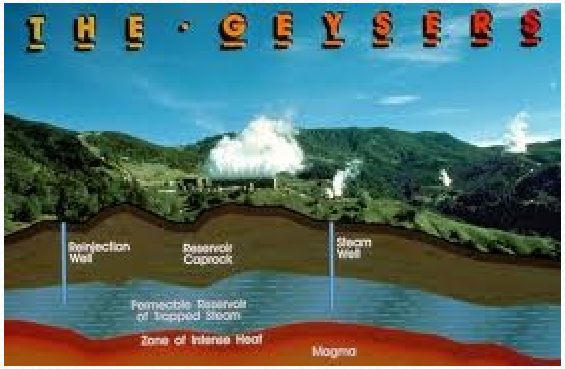
also referred to as the Snake River Plain is a volcanic hotspot responsible for large scale volcanism in Oregon, Nevada, Idaho, and Wyoming, United States. It created the eastern Snake River Plain through a succession of caldera forming eruptions. The resulting calderas include the Island Par Caldera, the Henry's Fork Caldera, and the Bruneau-Jarbidge caldera. The hotspot currently lies under the Yellowstone Caldera

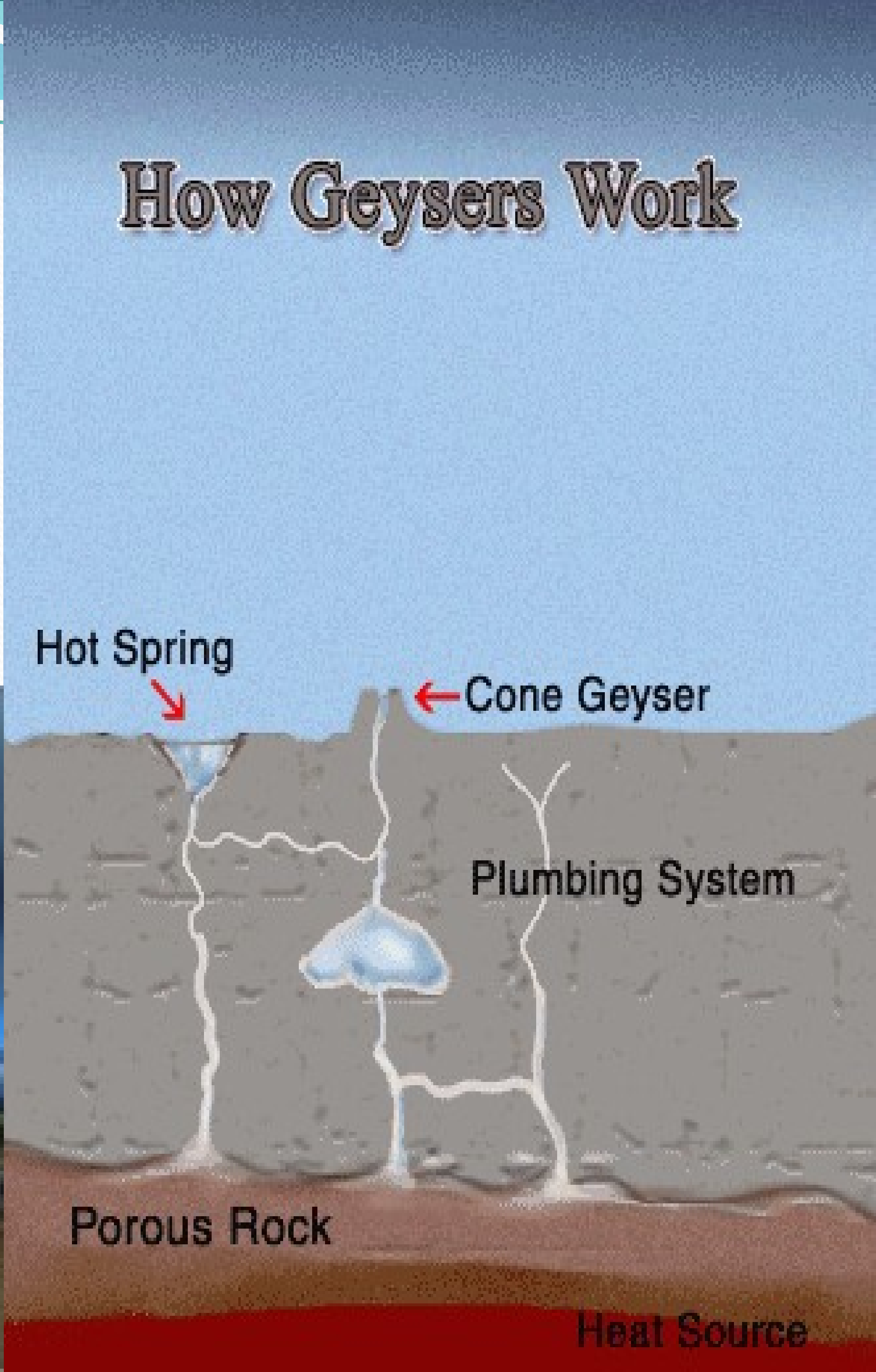
Volcanism in the American Northwest



YELLOWSTONE GEYSERS

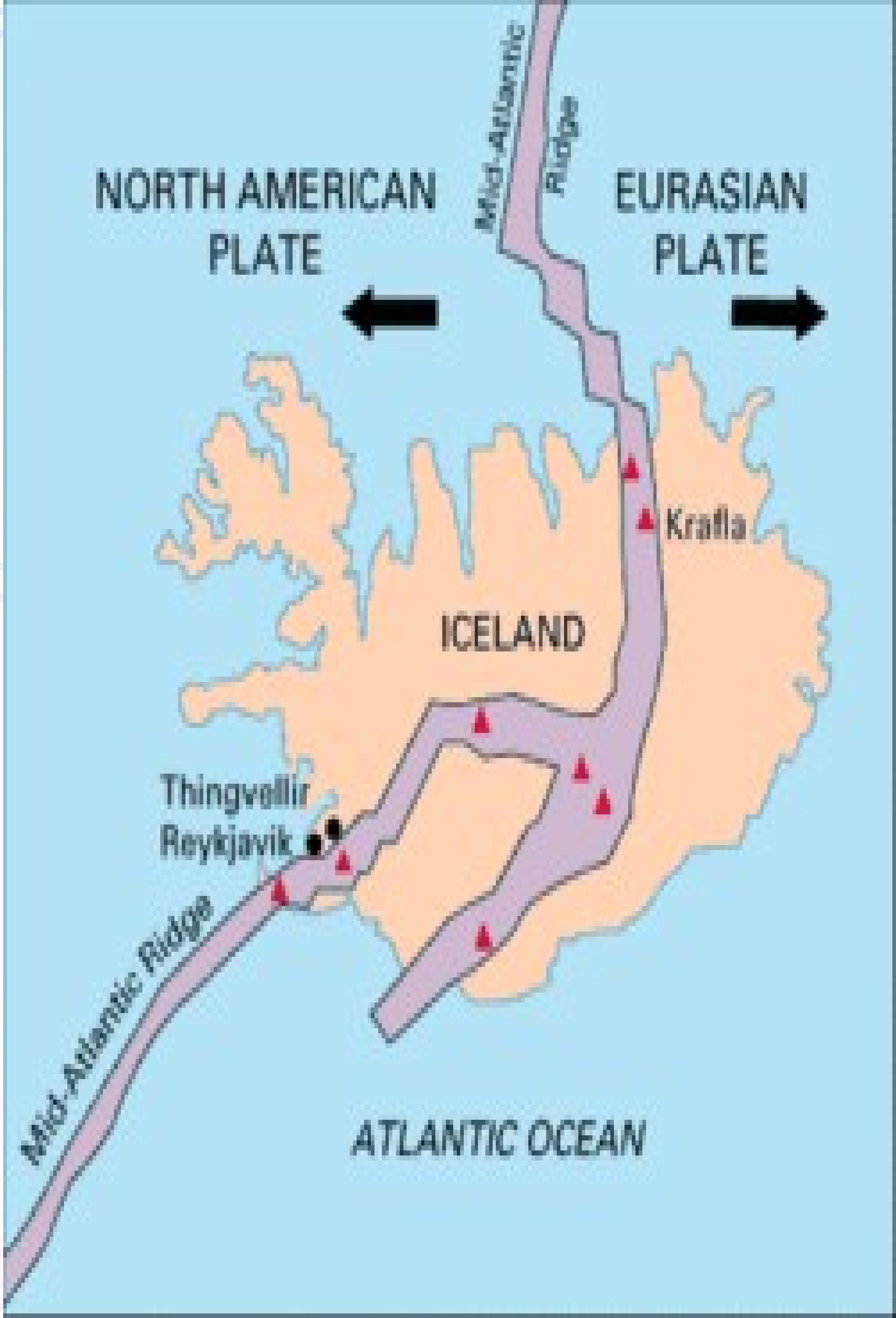
A geyser is a special type of hot spring that erupts periodically. For both geysers and groundwater circulating at depth becomes heated by the hot rock below and moves byconvection toward the surface.




How Geysers Work
Hot Spring
Cone Geyser
Plumbing System
Porous Rock
Heat Source

ICELAND HOTSPOT

- Iceland is one of the most active volcanic regions in the world, with eruptions occurring on average roughly every three years (in the 20th century there were 39 volcanic eruptions on and around Iceland) Iceland's location astride the Mid-Atlantic Ridge, where the Eurasian and North American Plates are moving apart, is partly responsible for this intense volcanic activity.


Mid-Atlantic Ridge
NORTH AMERICAN PLATE
EURASIAN PLATE
Krafla
ICELAND
Thingvellir
Reykjavik
Mid-Atlantic Ridge
ATLANTIC OCEAN

CONCLUSION

- Is one of the significant features of the Planet earth
- Plays a role in the formation of some part of the earth crust.
- They tell the story of how Overlying plates move with time